

What is claimed is:

1. A method of forming a tiered structure using a multi-layered resist stack comprising the steps of:

5 providing a substrate having a surface;

depositing and patterning a base resist layer on the surface of the substrate;

stabilizing the patterned base resist layer, thereby forming a stabilized resist layer;

10 depositing a resist stack on an uppermost surface of the stabilized resist layer;

patterning, in alignment with an opening defined in the stabilized resist layer, an opening in the resist stack having a reentrant profile and a dimension greater than the opening defined in the stabilized resist layer;

15 depositing a metal material within the opening defined therein the resist stack and the opening defined therein the stabilized resist layer; and

removing the resist stack and the stabilized resist layer, thereby exposing a tiered structure.

20 2. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 1 wherein the tiered structure is a T-gate structure.

3. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 2 wherein the step of providing a substrate having a surface includes providing a substrate formed of a semiconductor material.

5 4. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 3 wherein the step of depositing a base resist layer includes depositing a low to medium molecular weight, soluble, organic imageable material.

10 5. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 3 wherein the step of stabilizing the patterned base resist layer includes the step of exposing the base resist layer to one of a heat source, a light source, a heat source and a light source, an electron beam irradiation source, and an electron beam irradiation source and a heat
15 source, thereby increasing the molecular weight of the base resist layer through cross-linking, forming the stabilized base resist layer.

20 6. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of exposing the base resist layer to a light source includes exposing to an deep ultraviolet light source.

7. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of depositing the resist stack on

an uppermost surface of the stabilized resist layer includes forming a multiple layer resist stack.

8. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of depositing a metal material includes depositing a conductive metal material.

9. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 5 wherein the step of removing the resist stack and the stabilized base resist layer includes immersing the stack in a solvent bath immersion to remove the resist stack and etching to remove the stabilized base resist layer.

10. A method of forming a tiered structure using a multi-layered resist stack comprising the steps of:

- providing a semiconductor substrate having a surface;
- depositing a soluble organic imageable material on the surface of the substrate, thereby forming a base resist layer;
- patterning the base resist layer to define therein an opening having a first dimension;

stabilizing the base resist layer by exposing the base resist layer to one of a light source, a heat source, a combination of a light source and a heat source, an electron beam irradiation source, and a combination of an electron

beam irradiation source and a heat source, thereby increasing the molecular weight of the base resist layer through cross-linking and forming a stabilized resist layer having an opening defined therein;

5 forming a resist stack including an isotropically developing material formed on an uppermost surface of the stabilized resist layer and an imageable material formed on a surface of the isotropically developing material ;

10 patterning, in alignment with an opening defined in the stabilized resist layer, an opening in the imageable material and an opening in the isotropically developing material having a reentrant profile and a dimension greater than the opening defined in the stabilized resist layer;

depositing a metal material within the openings defined therein the resist stack and the opening defined therein the stabilized resist layer; and

15 removing the resist stack and the stabilized resist layer, thereby exposing a tiered structure.

11. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the tiered structure is a T-gate structure.

20 12. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of providing a substrate having a surface includes providing a substrate formed of a semiconducting material chosen from the group consisting of: column III-V compound semiconductors,

glass, metals, silicon.

13. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of depositing a base resist layer
5 includes depositing a low to medium molecular weight soluble organic imageable material.

14. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of exposing the base resist
10 layer to a light source includes exposing to a deep ultraviolet light source.

15. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 10 wherein the step of depositing a resist stack on an uppermost surface of the stabilized resist layer includes the step of
15 creating a reentrant resist profile in the upper resist layer by diffusing a base into an uppermost portion of the resist stack, and defining an isotropically developed material adjacent the stabilized resist layer.

16. A method of forming a tiered structure using a multi-layered resist
20 stack as claimed in claim 10 wherein the step of depositing a metal material includes depositing a conductive metal material.

17. A method of forming a tiered structure using a multi-layered resist

stack as claimed in claim 10 wherein the step of removing the resist stack and the stabilized resist layer includes immersing the stack in a solvent bath immersion to remove the resist stack and etching to remove the stabilized resist layer.

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18. A method of forming a semiconductor device comprising the steps

of:

providing a substrate having a surface;

forming a source on an uppermost surface of the substrate;

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forming a drain on an uppermost surface of the substrate;

fabricating a tiered structure including the steps of:

providing a substrate having a surface;

depositing and patterning a base resist layer on the surface of

the substrate;

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stabilizing the patterned base resist layer, thereby forming a stabilized resist layer;

depositing a resist stack on an uppermost surface of the stabilized resist layer;

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patterning, in alignment with an opening defined in the stabilized resist layer, an opening in the resist stack having a reentrant profile and a dimension greater than the opening defined in the stabilized resist layer;

depositing a metal material within the opening defined therein

the resist stack and the opening defined therein the stabilized resist layer; and

removing the resist stack and the stabilized resist layer, thereby exposing a tiered structure; and

5 positioning the tiered structure between the source and the drain, thereby forming a transistor.

19. A method of forming a semiconductor device as claimed in claim 18 wherein the step of depositing a base resist layer on the surface of the substrate includes depositing a low to medium molecular weight, soluble, organic imageable material.

20. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 19 wherein the step of stabilizing the patterned base resist layer includes the step of exposing the base resist layer to one of a heat source, a light source, a combination of a heat source and a light source, an electron beam irradiation source, and a combination of an electron beam irradiation source and a heat source, thereby increasing the molecular weight of the base resist layer through cross-linking and forming the stabilized resist layer.

21. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 20 wherein the step of exposing the base resist

layer to a light source includes exposing to a deep ultraviolet light source.

23. A method of forming a tiered structure using a multi-layered resist stack as claimed in claim 20 wherein the step of removing the at least one
5 resist layer and the stabilized resist layer includes immersing the stack in a solvent bath immersion to remove the at least one resist layer and etching to remove the stabilized resist layer.